Oceaneering Completes Dual-Well Hydraulic Intervention in Gulf of Mexico
Innovative single-vessel stimulation saves operator time and money

**Project Overview**
Oceaneering performed a single-vessel well stimulation on two 15-kpsi wells in approximately 4,300 fsw / 1,310 msw to enhance production by clearing sand that had accumulated in the wells.

**Issues**
The client considered available stimulation options, including dual-vessel and rig-based operations, but decided to pursue a more cost-effective alternative. Oceaneering proposed an innovative single-vessel approach as a lower-cost method. Because the treatment schedule volume exceeded a single vessel’s capacity using premixed chemicals, the treatment chemicals were mixed “on the fly” on an Oceaneering® multi-service vessel (MSV) during stimulation.

**The Oceaneering Solution**
Oceaneering worked with the client and the chemical provider to develop a treatment chemical and pumping schedule that enabled the Oceaneering® MSV to deliver the volumes required for well sand migration treatment.
Execution Plan
After detailed planning, the project team chose a suitable chemical matrix that enabled chemicals to be mixed on the fly and injected into the wells from the Oceaneering® Olympic Intervention IV vessel. Using this approach, the amount of pre-mixed chemicals that needed to be stored on the vessel was reduced significantly, enabling a single vessel to carry out the stimulation. Oceaneering worked with DNV GL to determine the allowable chemicals that could be transported internally and externally. The project team developed a spill and fire response plan for the approved chemicals.

To effectively stimulate the wells, each intervention required 12–15 hours of continuous pumping. This was a challenge because the project was scheduled during winter in potentially difficult weather. Oceaneering developed an operability matrix to allow for a 24-hour pumping window to meet the demanding pumping schedule. Weather, current, and sea states were monitored and this data was placed into the operability matrix to ensure that pumping operations were not interrupted. Additionally, the vessel carried double pumping redundancy to reduce any potential risk of pumping downtime.

From Port Fourchon, Louisiana, Oceaneering mobilized the intervention vessel with the required 2,400 hydraulic pump horsepower and with dual redundancy, nitrogen, nitrogen pumps, dual-coiled-tubing units, 2,500 bbl of bulk chemical, mixing units, and the Oceaneering® Well Stimulation Tool (WST). The WST provided access to the well and acted as a control barrier. This tool was the means of proving well shut-in, and it supplied a disconnect solution in the event of an emergency. Two Oceaneering® Millennium® Plus remotely operated vehicles (ROVs) were instrumental in providing the tree, WST, and coil connection interface and monitoring.

All chemicals were pumped per schedule, and treatment well data indicated a successful stimulation of each well.

Challenges
Working with the client and vendors to demonstrate that a single-vessel stimulation plan was a feasible alternative to rig-based or dual-vessel stimulation.

Mixing chemicals on the fly was a first for the client and Oceaneering. Significant planning and testing were required. Chemical quality was checked prior to vessel departure by a third-party fluids provider and then rechecked for quality prior to pumping downhole post-mixing to ensure proper weighting, concentration percentage and pH. Metering skids on the vessel were calibrated and commissioned for accuracy prior to mobilization, and then calibrated again once secured on the vessel.

Another challenge was developing an operability matrix in order to achieve the extended, uninterrupted pumping required for successful stimulation. The matrix ensured that harsh winter conditions would not affect pumping operations.

Equipment Highlights
The equipment deployed on the Oceaneering® Olympic Intervention IV vessel provided:

» Onboard mixing and metering capabilities to enable chemical mixing on the fly and to
significantly reduce the amount of required pre-mixed chemicals
» Dual-redundancy pumping equipment to ensure uninterrupted pumping capabilities
» Hydraulic pumps, nitrogen, nitrogen pumps and dual-coiled-tubing units to enable success in this innovative, cost-effective stimulation project.

**Project Highlights**
» First single-vessel stimulation for the client
» First on-the-fly mixing of chemicals for a stimulation for both Oceaneering and the client
» Operability matrix planning approach enabled continued pumping despite variable weather and ocean conditions

Results
At U.S. Bureau of Safety and Environmental Enforcement (BSEE) approval meetings, the combined efforts of the Oceaneering team and the client’s team resulted in BSEE approval for the single-vessel stimulation method.

The client benefited from an optimal, cost-effective solution for a single-vessel stimulation, and also realized savings of 20% when compared to rig-based methods and up to USD 70,000 per day when compared to dual-vessel operations. The operation had no pumping or stimulation downtime. The project was completed ahead of schedule and under budget.

Development of a robust front-end engineering and design (FEED) and safety case to demonstrate to the client and its partners that a rigless and riserless stimulation could be performed successfully

Implementation of robust and safe operational procedures and mitigations through multiple hazard identifications (HAZIDs) and a stimulating well on paper (SWOP) exercise. The SWOP exercise allowed the team to simulate performing the full job by reviewing the procedure step by step. A comprehensive review of possible risks was completed, with each step examined and preventive measures, if required, identified and implemented prior to completing the project task offshore.

The operation had no pumping or stimulation downtime, and the project was completed ahead of schedule and under budget. Based on these results and the project’s success, the client has scheduled stimulations of additional wells, using the single-vessel method.